

**WATER SYSTEM ANALYSIS  
FOR  
QUARRY CREEK**

March 23, 2012



Prepared by:  
Dexter Wilson Engineering, Inc.  
2234 Faraday Avenue  
Carlsbad, CA 92008  
(760) 438-4422

Job No.: 691-010

# DEXTER WILSON ENGINEERING, INC.

---

DEXTER S. WILSON, P.E.  
ANDREW M. OVEN, P.E.  
STEPHEN M. NIELSEN, P.E.  
DIANE H. SHAUGHNESSY, P.E.  
NATALIE J. FRASCHETTI, P.E.

March 23, 2012

691-010

McMillin Land Development  
2750 Womble Road  
San Diego, CA 92106

Attention: Don Mitchell, Senior Vice President

Subject: Quarry Creek Water System Analysis

## **Introduction**

This letter-report summarizes our evaluation of the water system that will serve the proposed Quarry Creek project. The project is located along the south side of Freeway 78, just west of College Boulevard. Figure 1 provides a location map for the project.

The proposed land use for the project includes mixed density residential homes with a maximum of 656 units, public use areas, and open space areas. The project area is within the Carlsbad Municipal Water District for service. This study provides recommendations for public lines within the site, but does not evaluate water service laterals or meter sizing for non-residential sites.

## **Water Service Design Criteria**

The water system planning criteria used in this study are in accordance with the City of Carlsbad Water Design Procedures and Guidelines, last revised November 30, 2009. The criteria pertinent to this study are summarized below:





FIGURE 1

LOCATION MAP  
QUARRY CREEK



- Minimum Pressure, Static = 60 psi
- Maximum Pressure, Static = 125 psi (up to 150 psi allowed with approval of City Engineer)
- Minimum Pressure, Peak Hour = 40 psi
- Minimum Pressure, Max Day plus Fire = 20 psi
- SF Residential Demand Factor = 550 gpd/unit
- MF Residential Demand Factor = 250 gpd/unit
- Commercial Demand Factor = 2,300 gpd/10,000 SF Bldg. Area (assume building coverage of 30 percent of gross acreage)
- Max Day Factor = 1.65 x Average Day Demand
- Peak Hour Factor = 2.9 x Average Day Demand
- SF Residential Fire Flow = 1,500 gpm
- MF Residential Fire Flow = 3,000 gpm
- Commercial Fire Flow = 4,000 gpm
- Maximum Pipeline Velocity, Peak Hour = 8.0 ft./s

The actual fire flow requirement will be provided by the fire marshal based on the Uniform Fire Code. The fire flow requirement is based on building footprints, construction materials, and what reduction, if any, will be allowed for buildings with sprinklers. Since some of these factors are unknown at this planning stage, the fire flow requirements listed above were utilized.

### **Projected Water Demand**

Based on the demand factors presented above, Table 1 summarizes the projected water demands for the project. For non-residential acreage, the assumption of 30 percent building coverage and a demand factor of 2,300 gpd/10,000 square feet result in a demand factor of approximately 3,000 gpd per gross acre.

**TABLE 1  
QUARRY CREEK  
PROJECTED WATER DEMANDS**

| <b>Planning Area</b> | <b>Land Use</b>        | <b>Gross Acres</b> | <b>Maximum Dwelling Units</b> | <b>Demand Factor</b>  | <b>Average Demand, gpd</b> |
|----------------------|------------------------|--------------------|-------------------------------|-----------------------|----------------------------|
| R-1                  | MF Residential         | 7.1                | 129                           | 250 gpd/unit          | 32,250                     |
| R-2                  | MF Residential         | 11.1               | 202                           | 250 gpd/unit          | 50,500                     |
| R-3                  | MF Residential         | 6.7                | 81                            | 250 gpd/unit          | 20,250                     |
| R-4                  | MF Residential         | 18.4               | 188                           | 250 gpd/unit          | 47,000                     |
| R-5                  | MF Residential         | 5.6                | 56                            | 250 gpd/unit          | 14,000                     |
| P-1                  | Public use             | 0.9                | ---                           | 0 gpd/ac <sup>1</sup> | 0                          |
| P-2                  | Public Use             | 2.1                | ---                           | 3,000 gpd/ac          | 6,300                      |
| P-3                  | Public Use             | 1.3                | ---                           | 3,000 gpd/ac          | 3,900                      |
| P-4                  | Public Use             | 3.3                | ---                           | 0 gpd/ac <sup>1</sup> | 0                          |
| P-5                  | Public Use             | 0.6                | ---                           | 0 gpd/ac <sup>1</sup> | 0                          |
| OS                   | Open Space             | 87.9               | ---                           | 0 gpd/ac              | 0                          |
| ---                  | Public Roads           | 11.0               | ---                           | 0 gpd/ac              | 0                          |
| ---                  | Oceanside <sup>2</sup> | 4.0                | ---                           | ---                   | ---                        |
| <b>TOTAL</b>         |                        | <b>156.0</b>       | <b>656</b>                    |                       | <b>174,200</b>             |

<sup>1</sup> These areas are to be irrigated with recycled water and do not require potable water service.

<sup>2</sup> The 4 acre parcel in the City of Oceanside adjacent to Planning Area R-1 is not part of the master plan, but may be served by the utilities installed for the master plan area. The land use for this parcel is not currently known, but it is anticipated that only a portion of the site will be developed as public use with minimal potable and recycled water usage. To receive potable and/or recycled water service from the CMWD system, the developed portion of the project will be required to annex to CMWD.

Based on a projected average daily demand of 174,200 gpd, the projected maximum day demand is 287,430 gpd (200 gpm) and the projected peak hour demand is 505,180 gpd (351 gpm). Several water conservation measures will be implemented with this project that may result in reduced water demand for the project.

### **Existing Water System**

There are numerous pipelines in different pressure zones in the vicinity of the project. Figure 2 graphically shows the location of existing facilities in the vicinity of the project and a brief description by pressure zone is provided below.

**580 Zone.** The primary supply of water to this area comes from the 580 Zone. The 580 Zone is supplied from the San Diego County Water Authority No. 4 aqueduct connection. There is a 21-inch 580 Zone transmission line that conveys flow from this connection to service areas located south of the Quarry Creek project. The 580 Zone also supplies lower pressure zones in the area.

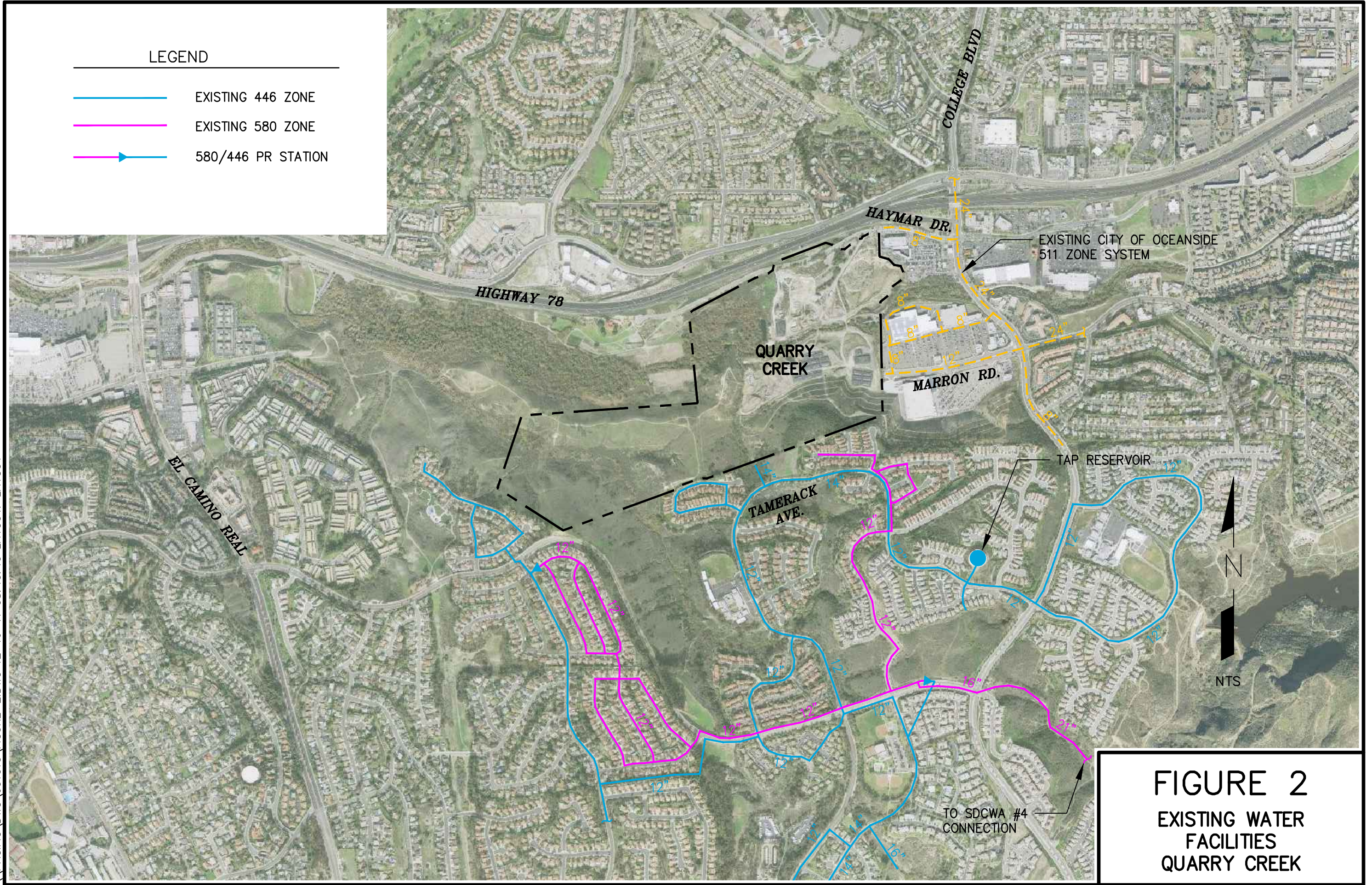
**446 Zone.** The 446 Zone is supplied by the Tap Reservoir located southwest of the Quarry Creek project. This reservoir has a capacity of 6.0 million gallons, a pad elevation of 446 feet, and a high water line of 473 feet. This reservoir and distribution system are supplied by 580/446 Zone pressure reducing stations in the area. A 580/446 Zone pressure reducing station is located along Carlsbad Village Drive south of the Tap Reservoir. There are 446 Zone distribution lines that have been extended to the southern boundary of the Quarry Creek project.

### **Proposed Water System**

Proposed pad elevations from the Quarry Creek project range in elevation from approximately 109 feet to 129 feet. Service to these areas from the 446 Zone would result in static pressures of 137 psi to 146 psi for the project. These pressures exceed the City's maximum recommended pressure of 125 psi, but are less than the maximum allowable pressure of 125 psi.

Providing adequate redundancy to the Quarry Creek project is complicated due to the project being bordered on the north and east by the City of Oceanside and by open space on the west. The existing 446 Zone piping to the south of the project is looped and appears to be the only feasible source of water to the project. To meet the redundancy and pressure requirements, it is proposed to make two connections to the existing 446 Zone with new







pressure reducing stations near each connection. The pressure reducing stations should be set for an output hydraulic gradeline of 330 feet to form a new onsite pressure zone. A gradeline of 330 feet would provide static pressures on the project ranging from 87 psi to 96 psi.

From the pressure reducing stations, a backbone water loop will be constructed onsite to serve the project. Planning Areas R-1, R-2, and R-3 do not have circulation loops to the rest of the project so these areas will require special consideration to meet City redundancy requirements. An internal pipe loop in Planning Area R-3 will provide redundancy to this area. There are two potential options for providing adequate redundancy to Planning Areas R-1 and R-2. These options include the installation of parallel pipelines to these areas and making emergency only connections to the City of Oceanside water system.

The installation of parallel water lines to meet redundancy requirements is allowed by other local agencies such as the City of San Diego. The system would include dual 12-inch pipelines across the bridge and an internal loop in Planning Area R-2.

Providing an emergency only connection to the City of Oceanside water system is also a viable alternative provided the City of Oceanside and City of Carlsbad can reach an agreement on these connections. As shown on Figure 2, the City of Oceanside system includes a 24-inch line in El Camino Real with an 8-inch line in Haymar Drive and a 12-inch line in Marron Road that have been extended to the Quarry Creek project boundary. The City of Oceanside system in this area is operated with a maximum hydraulic gradeline of 511 feet and so high pressures to the project would be a consideration. With service from the 511 Zone, maximum static pressures in the project would range from 165 psi to 174 psi. Thus, if this is the selected option, the onsite water system would need to be designed for these higher pressures or a pressure reducing valve would need to be installed at the connection.



### **Hydraulic Analysis**

Analysis using the KYPIPE computer software developed by the University of Kentucky determined residual pressures throughout the proposed water system. This computer software utilizes the Hazen-Williams equation for determining headloss in pipes. The Hazen-Williams "C" value used for all pipe sizes in our analysis is 120.

The system was modeled with an estimated hydraulic grade line of 430 feet at the connection to the existing 446 Zone. A gradeline of 330 feet was set at the 446/330 pressure reducing stations. The system has been designed to provide a minimum residual pressure of greater than 20 psi under a maximum day demand plus fire flow scenario at all locations within the proposed project development. For the project, fire flows were modeled at a few critical locations within the site.

The results of the computer analysis indicate that adequate water pressures are provided to the project. Furthermore, fire flow requirements are being met with greater than 20 psi residual pressure at all locations within the project. Appendix A provides the computer modeling output and Exhibit A provides the corresponding node and pipe diagram.

### **Recycled Water**

There are currently no recycled water facilities immediately adjacent to the property. The closest existing recycled water line is at the intersection of Tamarack Avenue and Harwich Drive.

The most recent recycled water master plan was prepared in 1997 by Carrollo Engineers. This document was supplemented by the May 2000 Encina Basin Recycled Water Distribution System study. Neither study specifically addresses the expansion of the recycled water system to the Quarry Creek area. However, the 2012 Recycled Water Master Plan Update that is in process does include Quarry Creek.



In keeping with the City's policy of using recycled water where possible to offset potable water use, it is recommended that piping be installed to the potential use areas within the site. A recycled water line will need to be extended offsite in Tamarack Avenue and connected to the existing system at Harwich Drive. The major potential use areas within the project are the public use sites and irrigated slopes. Figure 4 provides the proposed onsite recycled water facilities and potential use areas for the project.

### **Conclusions**

Water service can be provided to the Quarry Creek project by the Carlsbad Municipal Water District. Water service is proposed to be provided by connecting to the existing 446 Zone, and forming a new zone by constructing two new 446/330 Zone pressure reducing stations. The following conclusions have been made as a result of this study:

1. Figure 3 provides the proposed water system improvements for the project. Appendix A provides the hydraulic analysis used to verify recommended pipe sizing.
2. The northeastern portion of the project will require dual piping across the bridge and internal piping in Planning Area R-2 to meet redundancy requirements for this area.
3. An internal loop in Planning Area R-3 will be required to meet redundancy requirements to this area of the project.
4. Recycled water is proposed to be supplied to the project by constructing an offsite line in Tamarack Avenue and connecting to the existing distribution pipeline system. Figure 4 shows the proposed onsite recycled water system and potential recycled water use areas.



Don Mitchell  
March 23, 2012

---

If you have any questions on the information contained herein, please let us know.

Dexter Wilson Engineering, Inc.

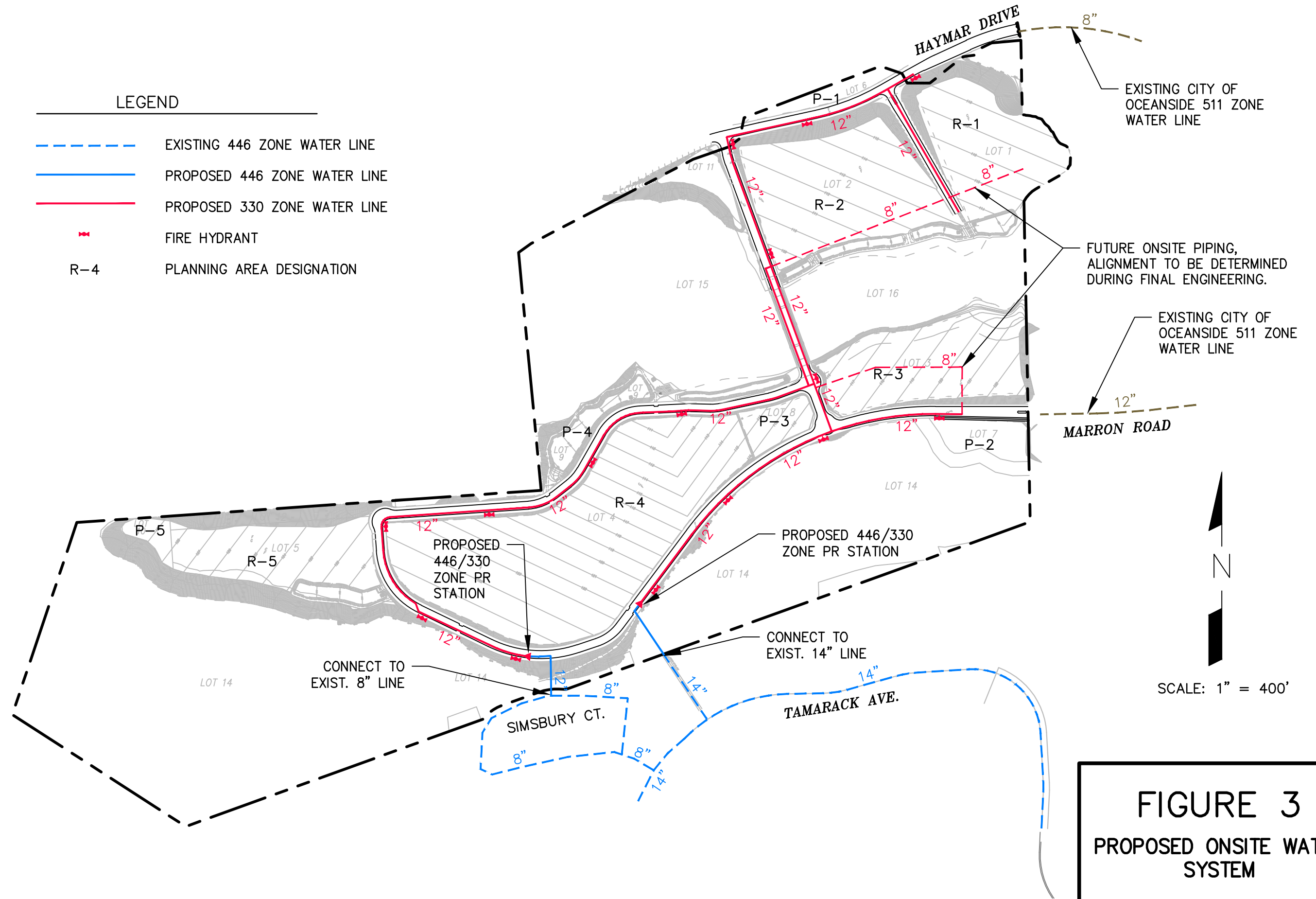


Stephen M. Nielsen

SMN:ck



\\PACIFIC\DWG\691010\FIGURE-3.DWG 03-05-12 11:49:31 LAYOUT: LAYOUT



\\PACIFIC\DWG\691010\FIGURE-4.DWG 03-05-12 13:50:38 LAYOUT: LAYOUT





## **APPENDIX A**

### **COMPUTER MODELING OUTPUT**

The following conditions were modeled:

1. Average Day Demands.
2. Maximum Day Demands plus 3,000 gpm at node 14.
3. Maximum Day Demands plus 3,000 gpm at node 26.
4. Maximum Day Demands plus 3,000 gpm at node 34.
5. Peak Hour Demands.



FLOWRATE IS EXPRESSED IN GPM AND PRESSURE IN PSIG

A SUMMARY OF THE ORIGINAL DATA FOLLOWS

THERE IS A PRV AT JUNCTION 10 FOR LINE 13 SET AT A GRADE OF 330.00  
 THERE IS A PRV AT JUNCTION 18 FOR LINE 21 SET AT A GRADE OF 330.00

| PIPE NO. | NODE NOS. | LENGTH<br>(FEET) | DIAMETER<br>(INCHES) | ROUGHNESS | MINOR LOSS K | FIXED GRADE |
|----------|-----------|------------------|----------------------|-----------|--------------|-------------|
| 1        | 0 2       | 900.0            | 14.0                 | 120.0     | .00          | 430.00      |
| 3        | 2 4       | 230.0            | 12.0                 | 120.0     | .00          |             |
| 5        | 4 6       | 180.0            | 8.0                  | 120.0     | .00          |             |
| 7        | 6 8       | 1100.0           | 8.0                  | 120.0     | .00          |             |
| 9        | 6 8       | 550.0            | 8.0                  | 120.0     | .00          |             |
| 11       | 8 10      | 150.0            | 12.0                 | 120.0     | .00          |             |
| 13       | 10 12     | 50.0             | 12.0                 | 120.0     | .00          |             |
| 15       | 12 14     | 1000.0           | 12.0                 | 120.0     | .00          |             |
| 17       | 2 16      | 350.0            | 14.0                 | 120.0     | .00          |             |
| 19       | 16 18     | 200.0            | 12.0                 | 120.0     | .00          |             |
| 21       | 18 20     | 50.0             | 12.0                 | 120.0     | .00          |             |
| 23       | 14 22     | 850.0            | 12.0                 | 120.0     | .00          |             |
| 25       | 20 24     | 1100.0           | 12.0                 | 120.0     | .00          |             |
| 27       | 22 28     | 1100.0           | 12.0                 | 120.0     | .00          |             |
| 29       | 24 28     | 250.0            | 12.0                 | 120.0     | .00          |             |
| 31       | 24 26     | 800.0            | 12.0                 | 120.0     | .00          |             |
| 33       | 28 30     | 1100.0           | 12.0                 | 120.0     | .00          |             |
| 35       | 30 32     | 700.0            | 12.0                 | 120.0     | .00          |             |
| 37       | 32 34     | 600.0            | 12.0                 | 120.0     | .00          |             |

| JUNCTION NUMBER | DEMAND | ELEVATION | CONNECTING PIPES |
|-----------------|--------|-----------|------------------|
| 2               | .00    | 148.00    | 1 3 17           |
| 4               | .00    | 165.00    | 3 5              |
| 6               | .00    | 170.00    | 5 7 9            |
| 8               | .00    | 165.00    | 7 9 11           |
| 10              | .00    | 122.00    | 11 13            |
| 12              | 12.00  | 122.00    | 13 15            |
| 14              | 11.00  | 122.00    | 15 23            |
| 16              | .00    | 133.00    | 17 19            |
| 18              | .00    | 123.00    | 19 21            |
| 20              | 12.00  | 123.00    | 21 25            |
| 22              | 14.00  | 120.00    | 23 27            |
| 24              | 3.00   | 114.00    | 25 29 31         |
| 26              | 17.00  | 119.00    | 31               |
| 28              | .00    | 114.00    | 27 29 33         |
| 30              | 14.00  | 120.00    | 33 35            |
| 32              | 20.00  | 130.00    | 35 37            |
| 34              | 18.00  | 115.00    | 37               |

OUTPUT SELECTION: ALL RESULTS ARE OUTPUT EACH PERIOD

# Quarry Creek Water System Analysis

12/13/11

THIS SYSTEM HAS MULTIPLE SUPPLY ZONES

ZONE NO. 1 IS SUPPLIED THROUGH THESE PIPES:

13  
21

THIS SYSTEM HAS 19 PIPES WITH 17 JUNCTIONS , 1 LOOPS AND 3 FGNS

THE RESULTS ARE OBTAINED AFTER 6 TRIALS WITH AN ACCURACY = .00126

QUARRY CREEK WATER SYSTEM ANALYSIS

691010A

## AVERAGE DAY DEMANDS

| PIPE NO. | NODE NOS. | FLOWRATE | HEAD LOSS | PUMP HEAD | MINOR LOSS | VELOCITY | HL/1000 |
|----------|-----------|----------|-----------|-----------|------------|----------|---------|
| 1        | 0 2       | 121.00   | .03       | .00       | .00        | .25      | .03     |
| 3        | 2 4       | 55.96    | .00       | .00       | .00        | .16      | .01     |
| 5        | 4 6       | 55.96    | .02       | .00       | .00        | .36      | .10     |
| 7        | 6 8       | 22.80    | .02       | .00       | .00        | .15      | .02     |
| 9        | 6 8       | 33.15    | .02       | .00       | .00        | .21      | .04     |
| 11       | 8 10      | 55.96    | .00       | .00       | .00        | .16      | .01     |
| 13       | 0 12      | 55.96    | .00       | .00       | .00        | .16      | .01     |
| 15       | 12 14     | 43.96    | .01       | .00       | .00        | .12      | .01     |
| 17       | 2 16      | 65.04    | .00       | .00       | .00        | .14      | .01     |
| 19       | 16 18     | 65.04    | .00       | .00       | .00        | .18      | .02     |
| 21       | 0 20      | 65.04    | .00       | .00       | .00        | .18      | .02     |
| 23       | 14 22     | 32.96    | .00       | .00       | .00        | .09      | .01     |
| 25       | 20 24     | 53.04    | .01       | .00       | .00        | .15      | .01     |
| 27       | 22 28     | 18.96    | .00       | .00       | .00        | .05      | .00     |
| 29       | 24 28     | 33.04    | .00       | .00       | .00        | .09      | .01     |
| 31       | 24 26     | 17.00    | .00       | .00       | .00        | .05      | .00     |
| 33       | 28 30     | 52.00    | .01       | .00       | .00        | .15      | .01     |
| 35       | 30 32     | 38.00    | .00       | .00       | .00        | .11      | .01     |
| 37       | 32 34     | 18.00    | .00       | .00       | .00        | .05      | .00     |

| JUNCTION NUMBER | DEMAND | GRADE LINE | ELEVATION | PRESSURE |
|-----------------|--------|------------|-----------|----------|
| 2               | .00    | 429.98     | 148.00    | 122.19   |
| 4               | .00    | 429.97     | 165.00    | 114.82   |
| 6               | .00    | 429.95     | 170.00    | 112.65   |
| 8               | .00    | 429.93     | 165.00    | 114.80   |
| 10              | .00    | 429.93     | 122.00    | 133.44   |
| 12              | 12.00  | 330.00     | 122.00    | 90.13    |
| 14              | 11.00  | 329.99     | 122.00    | 90.13    |
| 16              | .00    | 429.97     | 133.00    | 128.69   |
| 18              | .00    | 429.97     | 123.00    | 133.02   |
| 20              | 12.00  | 330.00     | 123.00    | 89.70    |
| 22              | 14.00  | 329.99     | 120.00    | 90.99    |
| 24              | 3.00   | 329.98     | 114.00    | 93.59    |
| 26              | 17.00  | 329.98     | 119.00    | 91.43    |
| 28              | .00    | 329.98     | 114.00    | 93.59    |
| 30              | 14.00  | 329.97     | 120.00    | 90.99    |
| 32              | 20.00  | 329.97     | 130.00    | 86.65    |
| 34              | 18.00  | 329.96     | 115.00    | 93.15    |



## Quarry Creek Water System Analysis

12/13/11

THE NET SYSTEM DEMAND = 121.00

SUMMARY OF INFLOWS (+) AND OUTFLOWS (-) FROM FIXED GRADE NODES

| PIPE NUMBER | FLOWRATE |
|-------------|----------|
| 1           | 121.00   |

THE NET FLOW INTO THE SYSTEM FROM FIXED GRADE NODES = 121.00

THE NET FLOW OUT OF THE SYSTEM INTO FIXED GRADE NODES = .00

# Quarry Creek Water System Analysis

12/13/11

A SUMMARY OF CONDITIONS SPECIFIED FOR THE NEXT SIMULATION FOLLOWS

THE DEMANDS ARE CHANGED FROM ORIGINAL VALUES BY A FACTOR = 1.65

THE FOLLOWING SPECIFIC DEMAND CHANGES ARE MADE :

| JUNCTION NUMBER | DEMAND  |
|-----------------|---------|
| 14              | 3018.00 |

THE RESULTS ARE OBTAINED AFTER 4 TRIALS WITH AN ACCURACY = .00001

## MAXIMUM DAY DEMANDS PLUS 3000 GPM FIRE FLOW AT NODE 14

| PIPE NO. | NODE NOS. | FLOWRATE | HEAD LOSS | PUMP HEAD | MINOR LOSS | VELOCITY | HL/1000 |
|----------|-----------|----------|-----------|-----------|------------|----------|---------|
| 1        | 0 2       | 3199.50  | 10.77     | .00       | .00        | 6.67     | 11.96   |
| 3        | 2 4       | 2029.42  | 2.51      | .00       | .00        | 5.76     | 10.91   |
| 5        | 4 6       | 2029.42  | 14.14     | .00       | .00        | 12.95    | 78.58   |
| 7        | 6 8       | 827.01   | 16.39     | .00       | .00        | 5.28     | 14.90   |
| 9        | 6 8       | 1202.41  | 16.39     | .00       | .00        | 7.67     | 29.81   |
| 11       | 8 10      | 2029.42  | 1.64      | .00       | .00        | 5.76     | 10.91   |
| 13       | 0 12      | 2029.42  | .55       | .00       | .00        | 5.76     | 10.91   |
| 15       | 12 14     | 2009.62  | 10.71     | .00       | .00        | 5.70     | 10.71   |
| 17       | 2 16      | 1170.08  | .65       | .00       | .00        | 2.44     | 1.86    |
| 19       | 16 18     | 1170.08  | .79       | .00       | .00        | 3.32     | 3.93    |
| 21       | 0 20      | 1170.08  | .20       | .00       | .00        | 3.32     | 3.93    |
| 23       | 14 22     | -1008.38 | -2.54     | .00       | .00        | -2.86    | -2.99   |
| 25       | 20 24     | 1150.28  | 4.19      | .00       | .00        | 3.26     | 3.81    |
| 27       | 22 28     | -1031.48 | -3.43     | .00       | .00        | -2.93    | -3.11   |
| 29       | 24 28     | 1117.28  | .90       | .00       | .00        | 3.17     | 3.61    |
| 31       | 24 26     | 28.05    | .00       | .00       | .00        | .08      | .00     |
| 33       | 28 30     | 85.80    | .03       | .00       | .00        | .24      | .03     |
| 35       | 30 32     | 62.70    | .01       | .00       | .00        | .18      | .02     |
| 37       | 32 34     | 29.70    | .00       | .00       | .00        | .08      | .00     |

| JUNCTION NUMBER | DEMAND  | GRADE LINE | ELEVATION | PRESSURE |
|-----------------|---------|------------|-----------|----------|
| 2               | .00     | 419.23     | 148.00    | 117.53   |
| 4               | .00     | 416.72     | 165.00    | 109.08   |
| 6               | .00     | 402.58     | 170.00    | 100.78   |
| 8               | .00     | 386.18     | 165.00    | 95.85    |
| 10              | .00     | 384.55     | 122.00    | 113.77   |
| 12              | 19.80   | 329.45     | 122.00    | 89.90    |
| 14              | 3018.00 | 318.74     | 122.00    | 85.26    |
| 16              | .00     | 418.58     | 133.00    | 123.75   |
| 18              | .00     | 417.80     | 123.00    | 127.74   |
| 20              | 19.80   | 329.80     | 123.00    | 89.61    |
| 22              | 23.10   | 321.28     | 120.00    | 87.22    |
| 24              | 4.95    | 325.61     | 114.00    | 91.70    |
| 26              | 28.05   | 325.61     | 119.00    | 89.53    |
| 28              | .00     | 324.71     | 114.00    | 91.31    |
| 30              | 23.10   | 324.67     | 120.00    | 88.69    |
| 32              | 33.00   | 324.66     | 130.00    | 84.35    |
| 34              | 29.70   | 324.66     | 115.00    | 90.85    |

THE NET SYSTEM DEMAND = 3199.50

## Quarry Creek Water System Analysis

12/13/11

SUMMARY OF INFLOWS (+) AND OUTFLOWS (-) FROM FIXED GRADE NODES

| PIPE NUMBER | FLOWRATE |
|-------------|----------|
| 1           | 3199.50  |

THE NET FLOW INTO THE SYSTEM FROM FIXED GRADE NODES = 3199.50  
THE NET FLOW OUT OF THE SYSTEM INTO FIXED GRADE NODES = .00



# Quarry Creek Water System Analysis

12/13/11

A SUMMARY OF CONDITIONS SPECIFIED FOR THE NEXT SIMULATION FOLLOWS

THE DEMANDS ARE CHANGED FROM ORIGINAL VALUES BY A FACTOR = 1.65

THE FOLLOWING SPECIFIC DEMAND CHANGES ARE MADE :

| JUNCTION NUMBER | DEMAND  |
|-----------------|---------|
| 26              | 3028.00 |

THE RESULTS ARE OBTAINED AFTER 4 TRIALS WITH AN ACCURACY = .00008

## MAXIMUM DAY DEMANDS PLUS 3000 GPM FIRE FLOW AT NODE 26

| PIPE NO. | NODE NOS. | FLOWRATE | HEAD LOSS | PUMP HEAD | MINOR LOSS | VELOCITY | HL/1000 |
|----------|-----------|----------|-----------|-----------|------------|----------|---------|
| 1        | 0 2       | 3199.60  | 10.77     | .00       | .00        | 6.67     | 11.97   |
| 3        | 2 4       | 1185.90  | .93       | .00       | .00        | 3.36     | 4.03    |
| 5        | 4 6       | 1185.90  | 5.23      | .00       | .00        | 7.57     | 29.05   |
| 7        | 6 8       | 483.26   | 6.06      | .00       | .00        | 3.08     | 5.51    |
| 9        | 6 8       | 702.63   | 6.06      | .00       | .00        | 4.48     | 11.02   |
| 11       | 8 10      | 1185.90  | .60       | .00       | .00        | 3.36     | 4.03    |
| 13       | 0 12      | 1185.90  | .20       | .00       | .00        | 3.36     | 4.03    |
| 15       | 12 14     | 1166.10  | 3.91      | .00       | .00        | 3.31     | 3.91    |
| 17       | 2 16      | 2013.70  | 1.78      | .00       | .00        | 4.20     | 5.08    |
| 19       | 16 18     | 2013.70  | 2.15      | .00       | .00        | 5.71     | 10.75   |
| 21       | 0 20      | 2013.70  | .54       | .00       | .00        | 5.71     | 10.75   |
| 23       | 14 22     | 1147.95  | 3.23      | .00       | .00        | 3.26     | 3.80    |
| 25       | 20 24     | 1993.90  | 11.61     | .00       | .00        | 5.66     | 10.56   |
| 27       | 22 28     | 1124.85  | 4.02      | .00       | .00        | 3.19     | 3.66    |
| 29       | 24 28     | -1039.05 | -.79      | .00       | .00        | -2.95    | -3.16   |
| 31       | 24 26     | 3028.00  | 18.31     | .00       | .00        | 8.59     | 22.89   |
| 33       | 28 30     | 85.80    | .03       | .00       | .00        | .24      | .03     |
| 35       | 30 32     | 62.70    | .01       | .00       | .00        | .18      | .02     |
| 37       | 32 34     | 29.70    | .00       | .00       | .00        | .08      | .00     |

| JUNCTION NUMBER | DEMAND  | GRADE LINE | ELEVATION | PRESSURE |
|-----------------|---------|------------|-----------|----------|
| 2               | .00     | 419.23     | 148.00    | 117.53   |
| 4               | .00     | 418.30     | 165.00    | 109.76   |
| 6               | .00     | 413.07     | 170.00    | 105.33   |
| 8               | .00     | 407.01     | 165.00    | 104.87   |
| 10              | .00     | 406.41     | 122.00    | 123.24   |
| 12              | 19.80   | 329.80     | 122.00    | 90.05    |
| 14              | 18.15   | 325.89     | 122.00    | 88.35    |
| 16              | .00     | 417.46     | 133.00    | 123.26   |
| 18              | .00     | 415.30     | 123.00    | 126.67   |
| 20              | 19.80   | 329.46     | 123.00    | 89.47    |
| 22              | 23.10   | 322.66     | 120.00    | 87.82    |
| 24              | 4.95    | 317.85     | 114.00    | 88.33    |
| 26              | 3028.00 | 299.54     | 119.00    | 78.23    |
| 28              | .00     | 318.64     | 114.00    | 88.68    |
| 30              | 23.10   | 318.60     | 120.00    | 86.06    |
| 32              | 33.00   | 318.59     | 130.00    | 81.72    |
| 34              | 29.70   | 318.59     | 115.00    | 88.22    |

THE NET SYSTEM DEMAND = 3199.60

## Quarry Creek Water System Analysis

12/13/11

SUMMARY OF INFLOWS (+) AND OUTFLOWS (-) FROM FIXED GRADE NODES

| PIPE NUMBER | FLOWRATE |
|-------------|----------|
| 1           | 3199.60  |

THE NET FLOW INTO THE SYSTEM FROM FIXED GRADE NODES = 3199.60  
THE NET FLOW OUT OF THE SYSTEM INTO FIXED GRADE NODES = .00

# Quarry Creek Water System Analysis

12/13/11

A SUMMARY OF CONDITIONS SPECIFIED FOR THE NEXT SIMULATION FOLLOWS

THE DEMANDS ARE CHANGED FROM ORIGINAL VALUES BY A FACTOR = 1.65

THE FOLLOWING SPECIFIC DEMAND CHANGES ARE MADE :

| JUNCTION NUMBER | DEMAND  |
|-----------------|---------|
| 34              | 3030.00 |

THE RESULTS ARE OBTAINED AFTER 3 TRIALS WITH AN ACCURACY = .00005

## MAXIMUM DAY DEMANDS PLUS 3000 GPM FIRE FLOW AT NODE 34

| PIPE NO. | NODE NOS. | FLOWRATE | HEAD LOSS | PUMP HEAD | MINOR LOSS | VELOCITY | HL/1000 |
|----------|-----------|----------|-----------|-----------|------------|----------|---------|
| 1        | 0 2       | 3199.95  | 10.77     | .00       | .00        | 6.67     | 11.97   |
| 3        | 2 4       | 1289.22  | 1.08      | .00       | .00        | 3.66     | 4.71    |
| 5        | 4 6       | 1289.22  | 6.10      | .00       | .00        | 8.23     | 33.92   |
| 7        | 6 8       | 525.37   | 7.08      | .00       | .00        | 3.35     | 6.43    |
| 9        | 6 8       | 763.85   | 7.08      | .00       | .00        | 4.88     | 12.86   |
| 11       | 8 10      | 1289.22  | .71       | .00       | .00        | 3.66     | 4.71    |
| 13       | 0 12      | 1289.22  | .24       | .00       | .00        | 3.66     | 4.71    |
| 15       | 12 14     | 1269.42  | 4.57      | .00       | .00        | 3.60     | 4.57    |
| 17       | 2 16      | 1910.73  | 1.61      | .00       | .00        | 3.98     | 4.61    |
| 19       | 16 18     | 1910.73  | 1.95      | .00       | .00        | 5.42     | 9.76    |
| 21       | 0 20      | 1910.73  | .49       | .00       | .00        | 5.42     | 9.76    |
| 23       | 14 22     | 1251.27  | 3.79      | .00       | .00        | 3.55     | 4.45    |
| 25       | 20 24     | 1890.93  | 10.53     | .00       | .00        | 5.36     | 9.57    |
| 27       | 22 28     | 1228.17  | 4.73      | .00       | .00        | 3.48     | 4.30    |
| 29       | 24 28     | 1857.93  | 2.32      | .00       | .00        | 5.27     | 9.26    |
| 31       | 24 26     | 28.05    | .00       | .00       | .00        | .08      | .00     |
| 33       | 28 30     | 3086.10  | 26.08     | .00       | .00        | 8.75     | 23.71   |
| 35       | 30 32     | 3063.00  | 16.37     | .00       | .00        | 8.69     | 23.38   |
| 37       | 32 34     | 3030.00  | 13.75     | .00       | .00        | 8.59     | 22.92   |

| JUNCTION NUMBER | DEMAND  | GRADE LINE | ELEVATION | PRESSURE |
|-----------------|---------|------------|-----------|----------|
| 2               | .00     | 419.23     | 148.00    | 117.53   |
| 4               | .00     | 418.15     | 165.00    | 109.70   |
| 6               | .00     | 412.04     | 170.00    | 104.88   |
| 8               | .00     | 404.97     | 165.00    | 103.99   |
| 10              | .00     | 404.26     | 122.00    | 122.31   |
| 12              | 19.80   | 329.76     | 122.00    | 90.03    |
| 14              | 18.15   | 325.19     | 122.00    | 88.05    |
| 16              | .00     | 417.62     | 133.00    | 123.33   |
| 18              | .00     | 415.67     | 123.00    | 126.82   |
| 20              | 19.80   | 329.51     | 123.00    | 89.49    |
| 22              | 23.10   | 321.40     | 120.00    | 87.27    |
| 24              | 4.95    | 318.99     | 114.00    | 88.83    |
| 26              | 28.05   | 318.98     | 119.00    | 86.66    |
| 28              | .00     | 316.67     | 114.00    | 87.82    |
| 30              | 23.10   | 290.59     | 120.00    | 73.92    |
| 32              | 33.00   | 274.22     | 130.00    | 62.50    |
| 34              | 3030.00 | 260.47     | 115.00    | 63.04    |

THE NET SYSTEM DEMAND = 3199.95



## Quarry Creek Water System Analysis

12/13/11

SUMMARY OF INFLOWS(+) AND OUTFLOWS(-) FROM FIXED GRADE NODES

| PIPE NUMBER | FLOWRATE |
|-------------|----------|
| 1           | 3199.95  |

THE NET FLOW INTO THE SYSTEM FROM FIXED GRADE NODES = 3199.95

THE NET FLOW OUT OF THE SYSTEM INTO FIXED GRADE NODES = .00

# Quarry Creek Water System Analysis

12/13/11

A SUMMARY OF CONDITIONS SPECIFIED FOR THE NEXT SIMULATION FOLLOWS

THE DEMANDS ARE CHANGED FROM ORIGINAL VALUES BY A FACTOR = 2.90

THE RESULTS ARE OBTAINED AFTER 3 TRIALS WITH AN ACCURACY = .00003

## PEAK HOUR DEMANDS

| PIPE NO. | NODE NOS. | FLOWRATE | HEAD LOSS | PUMP HEAD | MINOR LOSS | VELOCITY | HL/1000 |
|----------|-----------|----------|-----------|-----------|------------|----------|---------|
| 1        | 0 2       | 350.90   | .18       | .00       | .00        | .73      | .20     |
| 3        | 2 4       | 162.27   | .02       | .00       | .00        | .46      | .10     |
| 5        | 4 6       | 162.27   | .13       | .00       | .00        | 1.04     | .73     |
| 7        | 6 8       | 66.13    | .15       | .00       | .00        | .42      | .14     |
| 9        | 6 8       | 96.15    | .15       | .00       | .00        | .61      | .28     |
| 11       | 8 10      | 162.27   | .02       | .00       | .00        | .46      | .10     |
| 13       | 0 12      | 162.27   | .01       | .00       | .00        | .46      | .10     |
| 15       | 12 14     | 127.47   | .06       | .00       | .00        | .36      | .06     |
| 17       | 2 16      | 188.63   | .02       | .00       | .00        | .39      | .06     |
| 19       | 16 18     | 188.63   | .03       | .00       | .00        | .54      | .13     |
| 21       | 0 20      | 188.63   | .01       | .00       | .00        | .54      | .13     |
| 23       | 14 22     | 95.57    | .03       | .00       | .00        | .27      | .04     |
| 25       | 20 24     | 153.83   | .10       | .00       | .00        | .44      | .09     |
| 27       | 22 28     | 54.97    | .02       | .00       | .00        | .16      | .01     |
| 29       | 24 28     | 95.83    | .01       | .00       | .00        | .27      | .04     |
| 31       | 24 26     | 49.30    | .01       | .00       | .00        | .14      | .01     |
| 33       | 28 30     | 150.80   | .10       | .00       | .00        | .43      | .09     |
| 35       | 30 32     | 110.20   | .03       | .00       | .00        | .31      | .05     |
| 37       | 32 34     | 52.20    | .01       | .00       | .00        | .15      | .01     |

| JUNCTION NUMBER | DEMAND | GRADE LINE | ELEVATION | PRESSURE |
|-----------------|--------|------------|-----------|----------|
| 2               | .00    | 429.82     | 148.00    | 122.12   |
| 4               | .00    | 429.80     | 165.00    | 114.75   |
| 6               | .00    | 429.67     | 170.00    | 112.52   |
| 8               | .00    | 429.51     | 165.00    | 114.62   |
| 10              | .00    | 429.50     | 122.00    | 133.25   |
| 12              | 34.80  | 329.99     | 122.00    | 90.13    |
| 14              | 31.90  | 329.93     | 122.00    | 90.10    |
| 16              | .00    | 429.80     | 133.00    | 128.61   |
| 18              | .00    | 429.77     | 123.00    | 132.93   |
| 20              | 34.80  | 329.99     | 123.00    | 89.70    |
| 22              | 40.60  | 329.90     | 120.00    | 90.96    |
| 24              | 8.70   | 329.89     | 114.00    | 93.55    |
| 26              | 49.30  | 329.88     | 119.00    | 91.38    |
| 28              | .00    | 329.88     | 114.00    | 93.55    |
| 30              | 40.60  | 329.79     | 120.00    | 90.91    |
| 32              | 58.00  | 329.75     | 130.00    | 86.56    |
| 34              | 52.20  | 329.74     | 115.00    | 93.06    |

THE NET SYSTEM DEMAND = 350.90

SUMMARY OF INFLOWS(+) AND OUTFLOWS(-) FROM FIXED GRADE NODES

| PIPE NUMBER | FLOWRATE |
|-------------|----------|
| 1           | 350.90   |

## Quarry Creek Water System Analysis

12/13/11

THE NET FLOW INTO THE SYSTEM FROM FIXED GRADE NODES = 350.90  
THE NET FLOW OUT OF THE SYSTEM INTO FIXED GRADE NODES = .00



\\PACIFIC\DWG\691010\EXHIBIT-A.DWG 12-16-11 08:57:13 LAYOUT: LAYOUT

